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**CLAIMS**

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**(57) [Claim(s)]**

[Claim 1] The environmental-temperature control unit at the time of the sleep characterized by to have the data-analysis equipment which performs the comparison with the temperature sensor which detects the temperature of the body, a temperature adjustment device with an environmental-temperature adjustment function, and the temperature actual measurement inputted from the above-mentioned temperature sensor and the optimal temperature hysteresis for the sleep \*\*\*\* set up, and a temperature-control means carry out the above-mentioned temperature adjustment device based on the output signal from this data-analysis equipment, and make environmental temperature control.

[Claim 2] The environmental temperature control unit at the time of the sleep characterized by preparing the above-mentioned temperature adjustment device in the bolster for sleep in the environmental temperature control unit at the time of sleep according to claim 1.

[Claim 3] The environmental temperature control unit at the time of the sleep characterized by preparing the above-mentioned temperature adjustment device in the berth for sleep in the environmental temperature control unit at the time of sleep according to claim 1.

[Claim 4] The environmental temperature control unit at the time of the sleep characterized by preparing the above-mentioned temperature adjustment device in the air-conditioning machine in the environmental temperature control unit at the time of sleep according to claim 1.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] The invention in this application relates to the environmental temperature control unit at the time of the sleep which adjusts the environmental temperature so that comfortable sleep can be maintained.

[0002]

[Description of the Prior Art] Generally, although human being has the constant maintenance function of a very advanced temperature, it is known that this will fall sharply during sleep (Yoshikatsu Kawashima: 14th Japanese Society of Sleep Research scientific meeting program / abstract collection and 1-27 reference), and it is easy to cause a cold caught while sleeping etc. for this reason, without the ability fully performing temperature adjustment to the fall of outside air temperature at dawn.

[0003] In view of such human being's living body function, so that it may be indicated by JP,63-28461,A A sleep state detection means to detect REM (rapid eye movement) sleep or NREM (non REM) sleep based on the output of biomedical signal detection sensors, such as a heartbeat sensor and a body motion sensor, It has the environmental temperature control means which controls an air conditioning means so that environmental temperature turns into predetermined temperature based on the condition detecting signal outputted from this sleep state detection means. The environmental temperature control unit with which the fall of the adjustment function of the temperature of a REM sleep condition was compensated by adjusting environmental temperature is proposed.

[0004]

[Problem(s) to be Solved by the Invention] However, as long as it is not only under the time of REM sleep but sleep, the fall of the temperature adjustment function under sleep is generated even when other, and for this reason, it is thought that effectiveness sufficient in what controls environmental temperature like a supra well-known example at the time of REM sleep is hard to be acquired.

[0005] Moreover, in the thing of this well-known example, since it is necessary to attach a heartbeat sensor and a body motion sensor, the structure of equipment itself is complicated and it is also considered that handling becomes complicated on the occasion of that use.

[0006] So, in the invention in this application, a comfortable sleep state can be maintained, moreover the environmental temperature control unit at the time of the sleep with the simple handling with easy and structure tends to be offered, and it is made.

[0007]

[Background of the Invention] The invention-in-this-application person is parallel to the descent with the earliness of falling asleep and the depth of sleep rapid [ rectal temperature ] and big. It is easy to carry out hypnagogic, so that temperature falls rapidly, and such a good sleep state that the temperature under sleep is low is acquired (Takuhiro Nishida: 14th Japanese Society of Sleep Research scientific meeting program / abstract collection, 1 -26 reference), And the thing for which rectal temperature begins to descend from sleeping before, the maximum low temperature is shown during sleeping, and the inclination to begin to go up before awakening is

shown (Yoshikatsu Kawashima: 14th Japanese Society of Sleep Research scientific meeting program / abstract collection and 1-27 reference), A sleep state very good when the decreased body temperature at the time of sleep is furthermore 0 or 6 degrees C or more is acquired. And it takes into consideration that the decreased body temperature under sleep arises from hypnagogic after 1 - 2-hour progress in many cases (Miyahara \*\*: 14th Japanese Society of Sleep Research scientific meeting program / abstract collection and 1-25 reference) etc. The typical temperature hysteresis considered that the best sleep state as shown in drawing 5 is acquired is assumed. It hits on an idea to control and have temperature actively, store the temperature under sleep within the limits of the optimal temperature hysteresis, and make a good sleep state secure by adjusting environmental temperature based on this temperature hysteresis during sleep.

[0008] In addition, in the temperature hysteresis of drawing 5 , the allowable-temperature range which shows the temperature from which a good sleep state is acquired, i.e., the target temperature which should be controlled, as a continuous line, and can be set in this case is set as the range surrounded with the broken line of the two upper and lower sides. It refers to supra \*\*\*\*\* about target temperature. At and the time of sleeping Temperature is reduced by about 1 degree C over about 90 minutes from the time of about 10 minutes having passed since (namely, the time of actuation of an environmental temperature control circuit). This temperature condition is made to maintain about 1 hour before a rising predetermined time, and conditioning is carried out so that temperature may be further raised by about 1 degree C over about 60 minutes from about 1 hour before a rising predetermined time.

[0009]

[Means for Solving the Problem] With the environmental temperature control unit at the time of the sleep concerning invention according to claim 1, as a concrete means for the invention in this application being based on this technical background, and solving the above-mentioned technical problem The temperature sensor 11 which detects the temperature of the body so that it may illustrate to drawing 1 , drawing 3 , or drawing 5 , The data analysis equipment 21 which performs the comparison with the temperature adjustment device 12 with an environmental temperature adjustment function, and the temperature actual measurement inputted from the above-mentioned temperature sensor 11 and the optimal temperature hysteresis for the sleep \*\*\*\* set up, It is characterized by having a temperature control means 22 to carry out the above-mentioned temperature adjustment device 12 based on the output signal from this data analysis equipment 21, and to make environmental temperature control.

[0010] Moreover, in the environmental temperature control unit at the time of the sleep concerning invention according to claim 2 to 4, the environmental temperature control unit at the time of sleep according to claim 1 is materialized more, and it is characterized by preparing the above-mentioned temperature adjustment device in the bolster 3 for sleep, the berth 2 for sleep, or the air-conditioning machine 4.

[0011]

[Function] In this application each invention, since it is adjusted by considering as this configuration at the time of sleep so that the temperature hysteresis which environmental temperature set [ \*\*\*\* ] up with the temperature adjustment device may be met, the temperature under sleep will be actively controlled by this environmental temperature, and this temperature will be stored in the tolerance of the temperature hysteresis from which the optimal sleep state is acquired through between the whole term under sleep.

[0012]

[Effect of the Invention] Therefore, according to this application each invention, since temperature is actively controlled based on the temperature hysteresis from which the optimal sleep state is acquired through between the whole term under sleep, human being can acquire a good sleep state through all the sleep periods from hypnagogic to awakening, and can contribute to the health maintenance by comfortable sleep.

[0013] Moreover, the structure of equipment is simplified, and as compared with the case where a heartbeat sensor, a body motion sensor, etc. are needed, for example like a supra well-known example, if the use is easy, it is closed, and the effectiveness that practicality improves further

is also acquired from control of the environmental temperature under sleep being performed only according to temperature.

[0014]

[Example] The environmental temperature control unit Z1 concerning claim 1 of this application and the example of invention given in two is shown in 1st example drawing 1, and the signs 1 of human being and 2 are [ a berth and 3 ] bolsters in this drawing. The environmental temperature control unit Z1 of this example contains the temperature adjustment device 12 which consists of a heat carrier or an electronic cooling element in the interior of the above-mentioned bolster 3, adjusts and has the environmental temperature of the human being 1 under sleep in it by performing the temperature control of this bolster 3, and he is trying to control that temperature actively to become the optimal temperature hysteresis.

[0015] And in order to control this temperature adjustment device 12, while arranging the temperature sensor 11 which detects that temperature to a human-being 1 side The output signal of this temperature sensor 11 is inputted into data analysis equipment 21, and it sets to this data analysis equipment 21. The actual measurement of a current temperature, The temperature hysteresis (refer to drawing 5) \*\*\*\* set up is compared, a signal is outputted to the temperature adjustment device 22 in order to store temperature in the optimal temperature hysteresis within the limits, based on the control signal from this temperature adjustment device 22, the above-mentioned temperature adjustment device 12 is carried out, and environmental temperature is made to adjust.

[0016] Though human being's 1 temperature is actively controlled by adjustment of such environmental temperature and the temperature adjustment function is falling as compared with the time of metaphor un-sleeping, temperature can be brought close to target temperature easily, and, as for human being 1, a good sleep state is acquired from hypnagogic through between the whole term under sleep to awakening.

[0017] Moreover, since control of the environmental temperature which can be set in this case is performed only based on temperature, simplification or simple use of the structure of equipment is attained.

[0018] Then, after control initiation (namely, after human being 1 prepared sleeping and operated the environmental temperature control unit Z1), if it explains based on the flow chart which shows the actual condition of this environmental temperature control to drawing 2, when human being 1 inputs a rising predetermined time ( $t'$ ) first, environmental temperature control will be started (step S1). That is, first, while measuring the temperature at the time of control initiation ( $T_0$ ) (step S2), based on the temperature hysteresis of drawing 5, the target temperature ( $T'$ ) in each elapsed time is determined (step S3).

[0019] Next, the present temperature ( $T$ ) is measured (step S4) and the deflection of observation temperature ( $T$ ) and target temperature ( $T'$ ) is judged (step S5), when deflection is smaller than a predetermined value ( $a$ : the allowable-temperature range of drawing 5), it judges that the present temperature is proper, and the present environmental temperature is maintained (step S9). In addition, the gain constant of temperature control was set as the small value at this allowable-temperature within the limits, it considered as mild control, and the temperature change is controlled.

[0020] On the other hand, when deflection is larger than a predetermined value ( $a$ ) When the direction of a bias is judged (step S6) and it inclines toward the forward side The temperature adjustment device 12 is controlled in order to raise environmental temperature (namely, when the observation temperature  $T$  is too low), when the temperature adjustment device 12 is controlled (step S7) and it inclines toward the negative side conversely in order to lower environmental temperature, (when [ namely, ] the observation temperature  $T$  is too high) (step S8). And control to this step S4 – step S9 is continued until a rising predetermined time ( $t'$ ) passes (step S10), and control is suspended at the progress time of a rising predetermined time.

[0021] Like the above, by performing control of environmental temperature, the temperature under sleep is always maintained in the tolerance of target temperature, and human being 1 can acquire a good sleep state from hypnagogic [ the ] through between the whole term to awakening.

[0022] in addition, as a temperature sensor 11 in the above-mentioned equipment Although various sensors, such as the thing using a thermocouple, the thing using a resistance bulb, the thing using a thermistor, a thing using a temperature-sensitive FE light, a thing using a supersonic wave, a thing using an optical fiber, a thing using microwave, and a thing using infrared radiation, are applicable Since the thing of the non-contact type especially using infrared radiation etc. has the free body motion of the human being 1 under sleep, it is [ no displeasure by wearing of the temperature sensor 11 ] and is suitable.

[0023] Moreover, although the temperature sensor 11, data analysis equipment 21, and the temperature adjustment device 22 are considered as another object configuration in the above-mentioned example, these can be considered as a coalesce configuration with the combination of arbitration.

[0024] Furthermore, as a correspondence procedure between the temperature sensor 11, data analysis equipment 21, and the temperature adjustment device 22, various methods, such as a cable system, an optical-fiber method, and an airborne communication method, are applicable.

[0025] The environmental temperature control unit Z2 concerning claim 1 of this application and the example of invention given in three is shown in 2nd example drawing 3 . To the thing of the 1st example of the above having arranged the temperature adjustment device 12 with the bolster 3, the environmental temperature control unit Z2 of this example arranges this temperature adjustment device 12 in a berth 2, adjusts the environmental temperature of the human being 1 under sleep from this berth 2 side, and is the same as that of the thing of the 1st example of the above about the other configuration. Therefore, the same operation effectiveness as the thing of the 1st example of the above is expectable.

[0026] The environmental temperature control unit Z3 concerning claim 1 of this application and the example of invention given in four is shown in 3rd example drawing 4 . The thing of this example is not that to which human being 1 adjusts the berth 2 which touches directly, and the temperature of a bolster 3 like the 1st or 2nd example of the above. Whenever [ blow-off temperature / of this air-conditioning machine 4 ] (namely, whenever [ room air temperature ]) is controlled using the air-conditioning machine 4. The point which carries out actuation control of the temperature adjustment device 12 prepared in this air-conditioning machine 4 with the control signal outputted from the temperature adjustment device 22 based on the signal from data analysis equipment 21 is the same as that of the case of each above-mentioned example.

[0027] Therefore, although the same operation effectiveness as the case of each above-mentioned example is acquired of course also in this example In addition, since it is what adjusts whenever [ room air temperature ] in the thing of this example, and performs human being's 1 temperature control by this, on the whole, the temperature control of this human being's 1 perimeter environment can be carried out. For example, there is an advantage that temperature control can perform more quickly a part of this human being's 1 perimeter environment as compared with the case where a temperature control is carried out locally, like each above-mentioned example.

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**TECHNICAL FIELD**

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[Industrial Application] The invention in this application relates to the environmental temperature control unit at the time of the sleep which adjusts the environmental temperature so that comfortable sleep can be maintained.

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**PRIOR ART**

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[Description of the Prior Art] Generally, although human being has the constant maintenance function of a very advanced temperature, it is known that this will fall sharply during sleep (Yoshikatsu Kawashima: 14th Japanese Society of Sleep Research scientific meeting program / abstract collection and 1-27 reference), and it is easy to cause a cold caught while sleeping etc. for this reason, without the ability fully performing temperature adjustment to the fall of outside air temperature at dawn.

[0003] In view of such human being's living body function, so that it may be indicated by JP,63-28461,A A sleep state detection means to detect REM (rapid eye movement) sleep or NREM (non REM) sleep based on the output of biomedical signal detection sensors, such as a heartbeat sensor and a body motion sensor, It has the environmental temperature control means which controls an air conditioning means so that environmental temperature turns into predetermined temperature based on the condition detecting signal outputted from this sleep state detection means. The environmental temperature control unit with which the fall of the adjustment function of the temperature of a REM sleep condition was compensated by adjusting environmental temperature is proposed.

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**EFFECT OF THE INVENTION**

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[Effect of the Invention] Therefore, according to this application each invention, since temperature is actively controlled based on the temperature hysteresis from which the optimal sleep state is acquired through between the whole term under sleep, human being can acquire a good sleep state through all the sleep periods from hypnagogic to awakening, and can contribute to the health maintenance by comfortable sleep.

[0013] Moreover, the structure of equipment is simplified, and as compared with the case where a heartbeat sensor, a body motion sensor, etc. are needed, for example like a supra well-known example, if the use is easy, it is closed, and the effectiveness that practicality improves further is also acquired from control of the environmental temperature under sleep being performed only according to temperature.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, as long as it is not only under the time of REM sleep but sleep, the fall of the temperature adjustment function under sleep is generated even when other, and for this reason, it is thought that effectiveness sufficient in what controls environmental temperature like a supra well-known example at the time of REM sleep is hard to be acquired.

[0005] Moreover, in the thing of this well-known example, since it is necessary to attach a heartbeat sensor and a body motion sensor, the structure of equipment itself is complicated and it is also considered that handling becomes complicated on the occasion of that use.

[0006] So, in the invention in this application, a comfortable sleep state can be maintained, moreover the environmental temperature control unit at the time of the sleep with the simple handling with easy and structure tends to be offered, and it is made.

[0007]

[Background of the Invention] The invention-in-this-application person is parallel to the descent with the earliness of falling asleep and the depth of sleep rapid [ rectal temperature ] and big. It is easy to carry out hypnagogic, so that temperature falls rapidly, and such a good sleep state that the temperature under sleep is low is acquired (Takuhiko Nishida: 14th Japanese Society of Sleep Research scientific meeting program / abstract collection, 1 -26 reference), And the thing for which rectal temperature begins to descend from sleeping before, the maximum low temperature is shown during sleeping, and the inclination to begin to go up before awakening is shown (Yoshikatsu Kawashima: 14th Japanese Society of Sleep Research scientific meeting program / abstract collection and 1-27 reference), A sleep state very good when the decreased body temperature at the time of sleep is furthermore 0 or 6 degrees C or more is acquired. And it takes into consideration that the decreased body temperature under sleep arises from hypnagogic after 1 - 2-hour progress in many cases (Miyahara \*\*: 14th Japanese Society of Sleep Research scientific meeting program / abstract collection and 1-25 reference) etc. The typical temperature hysteresis considered that the best sleep state as shown in drawing 5 is acquired is assumed. It hits on an idea to control and have temperature actively, store the temperature under sleep within the limits of the optimal temperature hysteresis, and make a good sleep state secure by adjusting environmental temperature based on this temperature hysteresis during sleep.

[0008] In addition, in the temperature hysteresis of drawing 5 , the allowable-temperature range which shows the temperature from which a good sleep state is acquired, i.e., the target temperature which should be controlled, as a continuous line, and can be set in this case is set as the range surrounded with the broken line of the-two upper and lower sides. It refers to supra \*\*\*\*\* about target temperature. At and the time of sleeping Temperature is reduced by about 1 degree C over about 90 minutes from the time of about 10 minutes having passed since (namely, the time of actuation of an environmental temperature control circuit). This temperature condition is made to maintain about 1 hour before a rising predetermined time, and conditioning is carried out so that temperature may be further raised by about 1 degree C over about 60 minutes from about 1 hour before a rising predetermined time.

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MEANS

[Means for Solving the Problem] With the environmental temperature control unit at the time of the sleep concerning invention according to claim 1, as a concrete means for the invention in this application being based on this technical background, and solving the above-mentioned technical problem The temperature sensor 11 which detects the temperature of the body so that it may illustrate to drawing 1 , drawing 3 , or drawing 5 , The data analysis equipment 21 which performs the comparison with the temperature adjustment device 12 with an environmental temperature adjustment function, and the temperature actual measurement inputted from the above-mentioned temperature sensor 11 and the optimal temperature hysteresis for the sleep \*\*\*\* set up, It is characterized by having a temperature control means 22 to carry out the above-mentioned temperature adjustment device 12 based on the output signal from this data analysis equipment 21, and to make environmental temperature control.

[0010] Moreover, in the environmental temperature control unit at the time of the sleep concerning invention according to claim 2 to 4, the environmental temperature control unit at the time of sleep according to claim 1 is materialized more, and it is characterized by preparing the above-mentioned temperature adjustment device in the bolster 3 for sleep, the berth 2 for sleep, or the air-conditioning machine 4.

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**OPERATION**

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[Function] In this application each invention, since it is adjusted by considering as this configuration at the time of sleep so that the temperature hysteresis which environmental temperature set [ \*\*\*\* ] up with the temperature adjustment device may be met, the temperature under sleep will be actively controlled by this environmental temperature, and this temperature will be stored in the tolerance of the temperature hysteresis from which the optimal sleep state is acquired through between the whole term under sleep.

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EXAMPLE

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[Example] The environmental temperature control unit Z1 concerning claim 1 of this application and the example of invention given in two is shown in 1st example drawing 1 , and the signs 1 of human being and 2 are [ a berth and 3 ] bolsters in this drawing. The environmental temperature control unit Z1 of this example contains the temperature adjustment device 12 which consists of a heat carrier or an electronic cooling element in the interior of the above-mentioned bolster 3, adjusts and has the environmental temperature of the human being 1 under sleep in it by performing the temperature control of this bolster 3, and he is trying to control that temperature actively to become the optimal temperature hysteresis.

[0015] And in order to control this temperature adjustment device 12, while arranging the temperature sensor 11 which detects that temperature to a human-being 1 side The output signal of this temperature sensor 11 is inputted into data analysis equipment 21, and it sets to this data analysis equipment 21. The actual measurement of a current temperature, The temperature hysteresis (refer to drawing 5 ) \*\*\*\* set up is compared, a signal is outputted to the temperature adjustment device 22 in order to store temperature in the optimal temperature hysteresis within the limits, based on the control signal from this temperature adjustment device 22, the above-mentioned temperature adjustment device 12 is carried out, and environmental temperature is made to adjust.

[0016] Though human being's 1 temperature is actively controlled by adjustment of such environmental temperature and the temperature adjustment function is falling as compared with the time of metaphor un-sleeping, temperature can be brought close to target temperature easily, and, as for human being 1, a good sleep state is acquired from hypnagogic through between the whole term under sleep to awakening.

[0017] Moreover, since control of the environmental temperature which can be set in this case is performed only based on temperature, simplification or simple use of the structure of equipment is attained.

[0018] Then, after control initiation (namely, after human being 1 prepared sleeping and operated the environmental temperature control unit Z1), if it explains based on the flow chart which shows the actual condition of this environmental temperature control to drawing 2 , when human being 1 inputs a rising predetermined time (t') first, environmental temperature control will be started (step S1). That is, first, while measuring the temperature at the time of control initiation (T0) (step S2), based on the temperature hysteresis of drawing 5 , the target temperature (T') in each elapsed time is determined (step S3).

[0019] Next, the present temperature (T) is measured (step S4) and the deflection of observation temperature (T) and target temperature (T') is judged (step S5), when deflection is smaller than a predetermined value (a : the allowable-temperature range of drawing 5 ), it judges that the present temperature is proper, and the present environmental temperature is maintained (step S9). In addition, the gain constant of temperature control was set as the small value at this allowable-temperature within the limits, it considered as mild control, and the temperature change is controlled.

[0020] On the other hand, when deflection is larger than a predetermined value (a) When the direction of a bias is judged (step S6) and it inclines toward the forward side The temperature

adjustment device 12 is controlled in order to raise environmental temperature (namely, when the observation temperature T is too low), when the temperature adjustment device 12 is controlled (step S7) and it inclines toward the negative side conversely in order to lower environmental temperature, (when [ namely, ] the observation temperature T is too high) (step S8). And control to this step S4 – step S9 is continued until a rising predetermined time (t') passes (step S10), and control is suspended at the progress time of a rising predetermined time. [0021] Like the above, by performing control of environmental temperature, the temperature under sleep is always maintained in the tolerance of target temperature, and human being 1 can acquire a good sleep state from hypnagogic [ the ] through between the whole term to awakening.

[0022] in addition, as a temperature sensor 11 in the above-mentioned equipment Although various sensors, such as the thing using a thermocouple, the thing using a resistance bulb, the thing using a thermistor, a thing using a temperature-sensitive FE light, a thing using a supersonic wave, a thing using an optical fiber, a thing using microwave, and a thing using infrared radiation, are applicable Since the thing of the non-contact type especially using infrared radiation etc. has the free-body motion of the human being 1 under sleep, it is [ no displeasure by wearing of the temperature sensor 11 ] and is suitable.

[0023] Moreover, although the temperature sensor 11, data analysis equipment 21, and the temperature adjustment device 22 are considered as another object configuration in the above-mentioned example, these can be considered as a coalesce configuration with the combination of arbitration.

[0024] Furthermore, as a correspondence procedure between the temperature sensor 11, data analysis equipment 21, and the temperature adjustment device 22, various methods, such as a cable system, an optical-fiber method, and an airborne communication method, are applicable.

[0025] The environmental temperature control unit Z2 concerning claim 1 of this application and the example of invention given in three is shown in 2nd example drawing 3 . To the thing of the 1st example of the above having arranged the temperature adjustment device 12 with the bolster 3, the environmental temperature control unit Z2 of this example arranges this temperature adjustment device 12 in a berth 2, adjusts the environmental temperature of the human being 1 under sleep from this berth 2 side, and is the same as that of the thing of the 1st example of the above about the other configuration. Therefore, the same operation effectiveness as the thing of the 1st example of the above is expectable.

[0026] The environmental temperature control unit Z3 concerning claim 1 of this application and the example of invention given in four is shown in 3rd example drawing 4 . The thing of this example is not that to which human being 1 adjusts the berth 2 which touches directly, and the temperature of a bolster 3 like the 1st or 2nd example of the above. Whenever [ blow-off temperature / of this air-conditioning machine 4 ] (namely, whenever [ room air temperature ]) is controlled using the air-conditioning machine 4. The point which carries out actuation control of the temperature adjustment device 12 prepared in this air-conditioning machine 4 with the control signal outputted from the temperature adjustment device 22 based on the signal from data analysis equipment 21 is the same as that of the case of each above-mentioned example.

[0027] Therefore, although the same operation effectiveness as the case of each above-mentioned example is acquired of course also in this example In addition, since it is what adjusts whenever [ room air temperature ] in the thing of this example, and performs human being's 1 temperature control by this, on the whole, the temperature control of this human being's 1 perimeter environment can be carried out. For example, there is an advantage that temperature control can perform more quickly a part of this human being's 1 perimeter environment as compared with the case where a temperature control is carried out locally, like each above-mentioned example.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the system chart of the environmental temperature control unit at the time of the sleep concerning the 1st example of the invention in this application.

[Drawing 2] It is the flows-of-control chart Fig. of the environmental temperature control device at the time of the sleep shown in drawing 1 .

[Drawing 3] It is the system chart of the environmental temperature control unit at the time of the sleep concerning the 2nd example of the invention in this application.

[Drawing 4] It is the system chart of the environmental temperature control unit at the time of the sleep concerning the 3rd example of the invention in this application.

[Drawing 5] It is the temperature-time amount correlation diagram showing the optimal temperature hysteresis for sleep.

[Description of Notations]

1 — human being and 2 — for an air-conditioning machine and 11, as for a temperature adjustment device and 21, a temperature sensor and 12 are [ a berth and 3 / a bolster and 4 / data analysis equipment and 22 ] temperature adjustment devices.

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[Translation done.]

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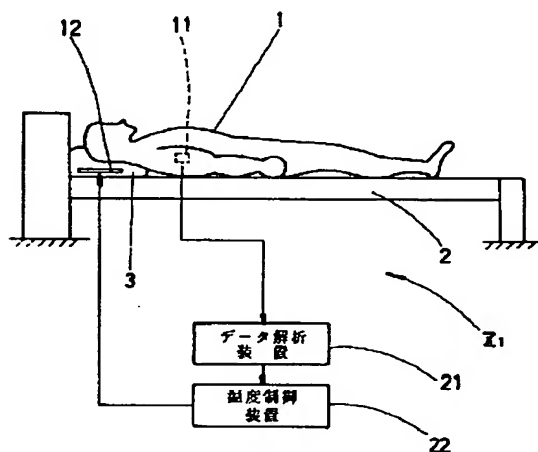
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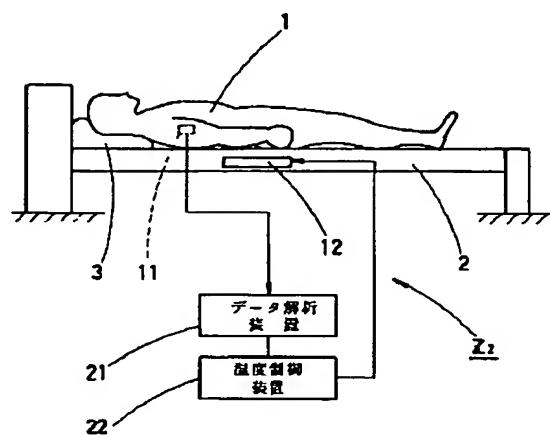
3.In the drawings, any words are not translated.

## DRAWINGS

[Drawing 1]

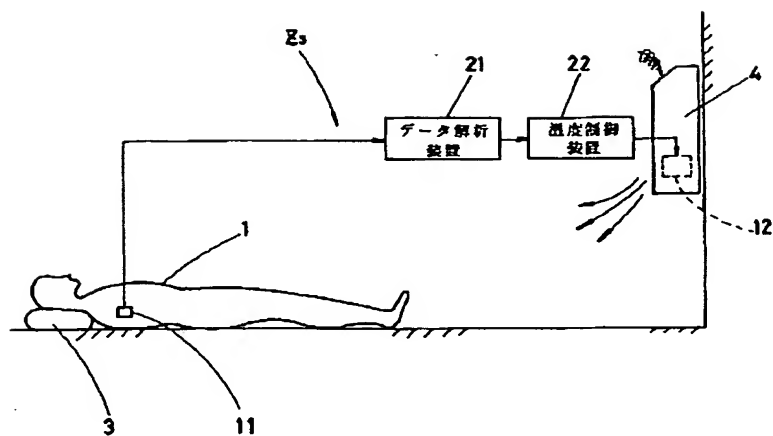


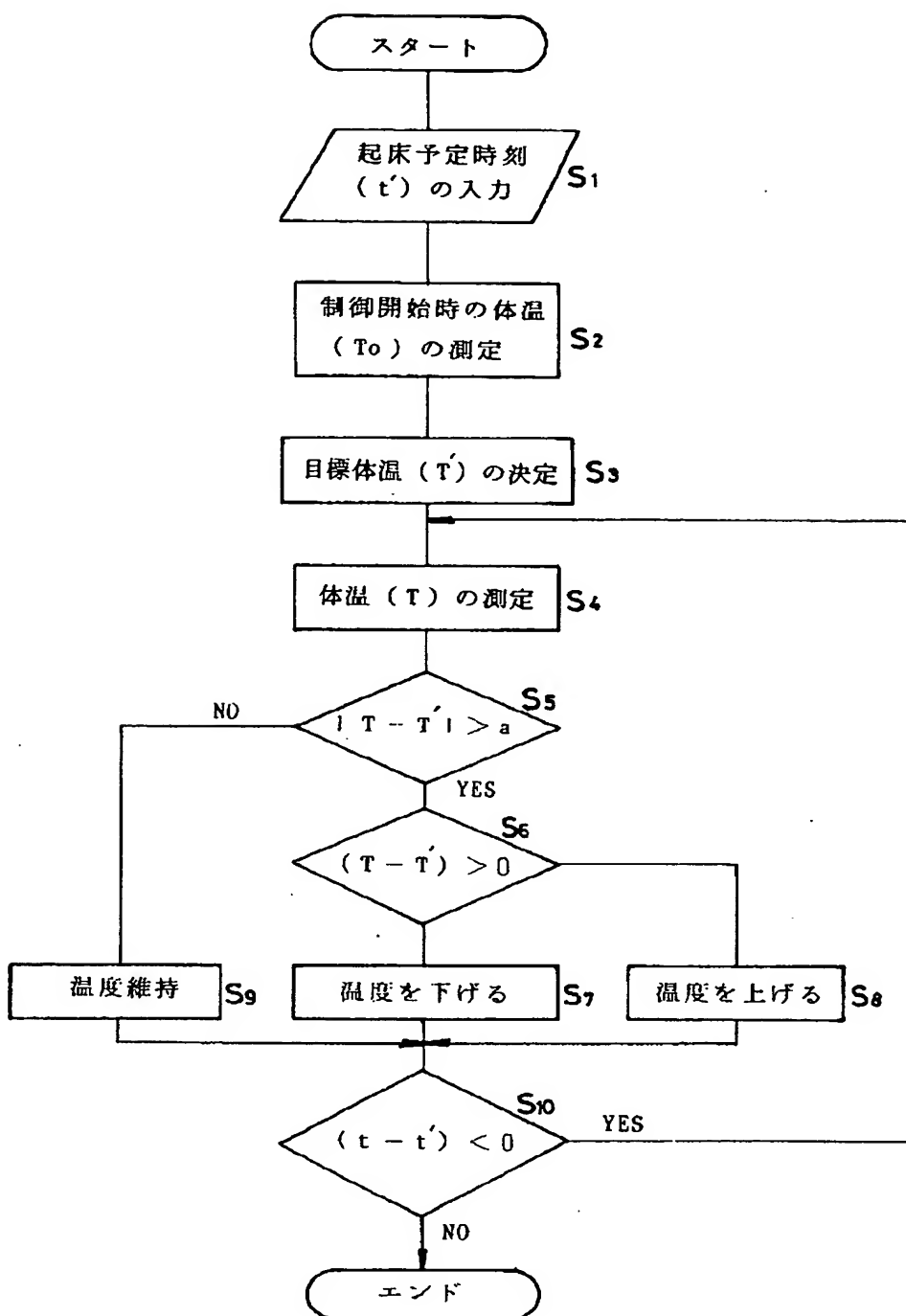
[Drawing 3]



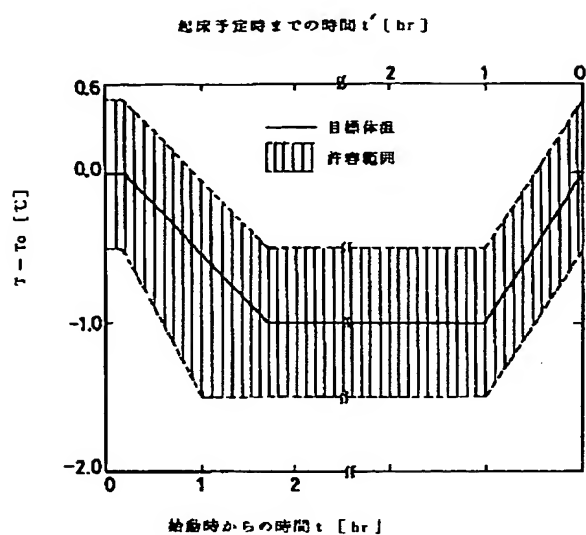
[Drawing 4]



[Drawing 2]



[Drawing 5]



[Translation done.]

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(54) 【発明の名称】 睡眠時における環境温度制御装置

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(57) 【特許請求の範囲】

【請求項 1】 人体の体温を検出する体温センサと、環境温度調整機能をもつ温度調整手段と、上記体温センサから入力される体温実測値と予め設定した睡眠に最適な体温履歴との比較を行うデータ解析装置と、該データ解析装置からの出力信号に基づいて上記温度調整手段をして環境温度を制御せしめる温度制御手段とを備えたことを特徴とする睡眠時における環境温度制御装置。

【請求項 2】 請求項 1 記載の睡眠時における環境温度制御装置において、上記温度調整手段が睡眠用枕に設けられていることを特徴とする睡眠時における環境温度制御装置。

【請求項 3】 請求項 1 記載の睡眠時における環境温度制御装置において、上記温度調整手段が睡眠用寝台に設けられていることを特徴とする睡眠時における環境温度

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制御装置。

【請求項 4】 請求項 1 記載の睡眠時における環境温度制御装置において、上記温度調整手段が空調機に設けられていることを特徴とする睡眠時における環境温度制御装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 本願発明は、快適な睡眠が持続できるようにその環境温度を調整する睡眠時における環境温度制御装置に関するものである。

【0002】

【従来の技術】 一般に、人間は非常に高度の体温の恒常性維持機能を有しているが、睡眠中にはこれが大幅に低下することが知られており(川島美勝:第 1 4 回日本睡眠学会学術集会プログラム・抄録集, 1-27 参照)、こ

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のため、例えば明け方の外気温の低下に対して体温調整が十分にできずに寝冷えなどを起こし易い。

【0003】このような人間の生体機能に鑑み、例えば特開昭63-28461号公報に開示されるように、心拍センサとか体動センサ等の生体信号検出センサの出力に基づいてREM(rapid eye movement)睡眠かNREM(non REM)睡眠かを検出する睡眠状態検出手段と、該睡眠状態検出手段から出力される状態検出信号に基づいて環境温度が所定温度となるように冷房手段を制御する環境温度制御手段とを備え、REM睡眠状態の体温の調整機能の低下を環境温度を調整することによって補うようにした環境温度制御装置が提案されている。

【0004】

【発明が解決しようとする課題】ところが、睡眠中における体温調整機能の低下はREM睡眠時に限らず、睡眠中である限りそれ以外の時でも発生するものであり、このため、上掲公知例のようにREM睡眠時においてのみ環境温度を制御するものでは十分な効果は得られにくいと考えられる。

【0005】また、この公知例のものにおいては、心拍センサや体動センサを取り付ける必要があることから、装置そのものの構造が複雑で、且つその使用に際しては取扱いが煩雑になることも考えられる。

【0006】そこで本願発明では、快適な睡眠状態が持続でき、しかも構造が簡単で且つその取扱いが簡易な睡眠中における環境温度制御装置を提供せんとしたものである。

【0007】

【発明の技術的背景】本願発明者は、寝付きの早さや眠りの深さは直腸温の急激且つ大きな下降と平行しており、体温が急激に低下するほど入眠し易く、また睡眠中の体温が低いほど良好な睡眠状態が得られること(西田卓弘:第14回日本睡眠学会学術集会プログラム・抄録集,1-26参照)、及び直腸温は就寝前より下降し始め、就寝中に最低温を示し、覚せい以前に上昇し始めるという傾向を示すこと(川島美勝:第14回日本睡眠学会学術集会プログラム・抄録集,1-27参照)、さらに睡眠時の体温低下が0.6℃以上の場合に極めて良好な睡眠状態が得られ、且つ睡眠中の体温低下は入眠から1~2時間経過後に起こることが多いこと(宮原靖:第14回日本睡眠学会学術集会プログラム・抄録集,1-25参照)、等を勘案して、図5に示すような、最も良好な睡眠状態が得られると思われる代表的な体温履歴を想定し、睡眠中は環境温度をこの体温履歴に基づいて調整することによって能動的に体温を制御し、もって睡眠中の体温を最適体温履歴の範囲内に収めて良好な睡眠状態を確保せしめることに想到したものである。

【0008】尚、図5の体温履歴においては、良好な睡眠状態が得られる体温、即ち制御すべき目標体温を実線で示し、またこの場合における許容温度範囲を上下二本

の破線で囲まれた範囲に設定している。そして、目標体温については、上掲各文献を参考にして、就寝時(即ち、環境温度制御回路の作動時)から約10分を経過した時点から約90分をかけて体温を約1℃低下させ、この温度状態を起床予定時間の約1時間前まで持続させ、さらに起床予定時間の約1時間前から約60分をかけて体温を約1℃上昇させるように条件設定をしている。

【0009】

【課題を解決するための手段】本願発明は、かかる技術背景に立脚するものであって、上記課題を解決するための具体的手段として、請求項1記載の発明にかかる睡眠中における環境温度制御装置では、図1、図3あるいは図5に例示するように、人体の体温を検出する体温センサ11と、環境温度調整機能をもつ温度調整手段12と、上記体温センサ11から入力される体温実測値と予め設定した睡眠に最適な体温履歴との比較を行うデータ解析装置21と、該データ解析装置21からの出力信号に基づいて上記温度調整手段12をして環境温度を制御せしめる温度制御手段22とを備えたことを特徴としている。

【0010】また、請求項2~4記載の発明にかかる睡眠中における環境温度制御装置では、請求項1記載の睡眠中における環境温度制御装置をより具体化し、上記温度調整手段を睡眠用枕3あるいは睡眠用寝台2あるいは空調機4に設けたことを特徴としている。

【0011】

【作用】本願各発明ではかかる構成とすることにより、睡眠時には、温度調整手段により環境温度が予め設定した体温履歴に沿うように調整されることから、睡眠中の体温がこの環境温度により能動的に制御され、該体温は睡眠中の全期間を通して最適睡眠状態が得られる体温履歴の許容範囲内に収められることとなる。

【0012】

【発明の効果】従って、本願各発明によれば、睡眠中の全期間を通して体温が、最適睡眠状態の得られる体温履歴に基づいて能動的に制御されることから、人間は入眠から覚せいまでの全睡眠期間を通じて良好な睡眠状態を得ることができ、快適睡眠による健康維持に寄与し得るものである。

【0013】また、睡眠中の環境温度の制御が体温のみによって行なわれることから、例えば上掲公知例のように心拍センサとか体動センサ等を必要とする場合に比して、装置の構造が簡略化され、且つその使用が容易ならしめられ、より一層実用性が向上するという効果も得られる。

【0014】

【実施例】第1実施例

図1には、本願の請求項1及び2記載の発明の実施例にかかる環境温度制御装置Z<sub>1</sub>が示されており、同図において符号1は人間、2は寝台、3は枕である。この実施

例の環境温度制御装置 $Z_1$ は、上記枕3の内部に、熱媒体あるいは電子冷却素子等で構成される温度調整手段12を内蔵し、該枕3の温度調整を行うことによって睡眠中の人間1の環境温度を調整し、もってその体温を最適な体温履歴となる如く能動的に制御するようにしている。

【0015】そして、この温度調整手段12の制御を行うために、人間1側にその体温を検出する体温センサ11を配置する一方、この体温センサ11の出力信号をデータ解析装置21に入力し、該データ解析装置21において現在の体温の実測値と、予め設定した体温履歴(図5参照)とを比較し、体温を最適な体温履歴範囲内に収めるべく、温度調整手段22に信号を出力し、該温度調整手段22からの制御信号に基づいて上記温度調整手段12をして環境温度の調整を行わしめるようになっている。

【0016】このような環境温度の調整により、能動的に人間1の体温が制御され、例えば非睡眠時に比して体温調整機能が低下していたとしても、容易に体温を目標体温に近付けることができ、人間1は入眠から覚せいまでの睡眠中の全期間を通して良好な睡眠状態が得られるものである。

【0017】また、この場合における環境温度の制御が体温のみに基づいて行なわれることから、装置の構造の簡略化あるいは簡便な使用が可能となるものである。

【0018】続いて、この環境温度制御の実際を、図2に示すフローチャートに基づいて説明すると、制御開始後(即ち、人間1が就寝の用意をし環境温度制御装置 $Z_1$ を起動させた後)、先ず人間1が起床予定時間( $t'$ )を入力することにより環境温度制御が開始される(ステップS1)。即ち、先ず、制御開始時における体温( $T_0$ )を測定するとともに(ステップS2)、図5の体温履歴に基づいて各経過時間における目標体温( $T'$ )を決定する(ステップS3)。

【0019】次に、現在の体温( $T$ )を測定し(ステップS4)、実測体温( $T$ )と目標体温( $T'$ )との偏差を判定し(ステップS5)、偏差が所定値( $a$ : 図5の許容温度範囲)より小さい場合には現在の体温は適正であると判断し、現在の環境温度を維持する(ステップS9)。尚、この許容温度範囲内においては、温度制御のゲイン定数を小さな値に設定してマイルドな制御とし、温度変化を抑制している。

【0020】一方、偏差が所定値( $a$ )より大きい場合には、その偏り方向を判定し(ステップS6)、正側に偏っている場合(即ち、実測体温 $T$ が高すぎる場合)には環境温度を下げるべく温度調整手段12の制御を行い(ステップS7)、逆に負側に偏っている場合(即ち、実測体温 $T$ が低すぎる場合)には環境温度を上昇させるべく温度調整手段12の制御を行う(ステップS8)。そして、このステップS4～ステップS9までの制御を、起床予定

時間( $t'$ )が経過するまで継続し(ステップS10)、起床予定時間の経過時点において制御を停止する。

【0021】以上の如く環境温度の制御が実行されることにより、睡眠中における体温が常時目標体温の許容範囲内に維持され、人間1はその入眠から覚せいまでの全期間を通じて良好な睡眠状態を得ることができるものである。

【0022】尚、上記装置における体温センサ11としては、熱電対を用いたもの、測温抵抗体を用いたもの、サーミスタを用いたもの、感温フェーライトを用いたもの、超音波を用いたもの、光ファイバーを用いたもの、マイクロ波を用いたもの、赤外線を用いたもの等、種々のセンサが適用可能であるが、特に赤外線等を用いた非接触式の場合は睡眠中の人間1の体動が自由であることから体温センサ11の装着による不快感がなく好適である。

【0023】また、上記実施例においては体温センサ11とデータ解析装置21と温度調整手段22とを別体構成としているが、これらは任意の組み合わせによって合体構成とすることができるものである。

【0024】さらに、体温センサ11とデータ解析装置21と温度調整手段22の間の通信方法としては、ケーブル方式、光ファイバー方式、空中通信方式等、種々の方式を適用することができる。

#### 【0025】第2実施例

図3には、本願の請求項1及び3記載の発明の実施例にかかる環境温度制御装置 $Z_2$ が示されている。この実施例の環境温度制御装置 $Z_2$ は、上記第1実施例のものが温度調整手段12を枕3に配置していたのに対して、該温度調整手段12を寝台2内に配置し、該寝台2側から睡眠中の人間1の環境温度を調整するようにしたものであり、それ以外の構成については上記第1実施例のものと同様である。従って、上記第1実施例のものと同様の作用効果が期待できる。

#### 【0026】第3実施例

図4には本願の請求項1及び4記載の発明の実施例にかかる環境温度制御装置 $Z_3$ が示されている。この実施例のものは、上記第1あるいは第2実施例のように人間1が直接的に接する寝台2とか枕3の温度を調整するものではなく、空調機4を使用して該空調機4の吹出温度(即ち、室内温度)を制御するようにしたものであり、該空調機4内に設けた温度調整手段12を、データ解析装置21からの信号に基づいて温度調整手段22から出力される制御信号により作動制御する点は上記各実施例の場合と同様である。

【0027】従って、この実施例においても上記各実施例の場合と同様の作用効果が得られることは勿論であるが、これに加えて、この実施例のものにおいては室内温度を調整しこれによって人間1の体温制御を行うものであるため該人間1の周囲環境を全体的に温度調整するこ

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とができ、例えば上記各実施例のように該人間1の周囲環境の一部を局部的に温度調整する場合に比して、体温制御がより迅速に行えるという利点がある。

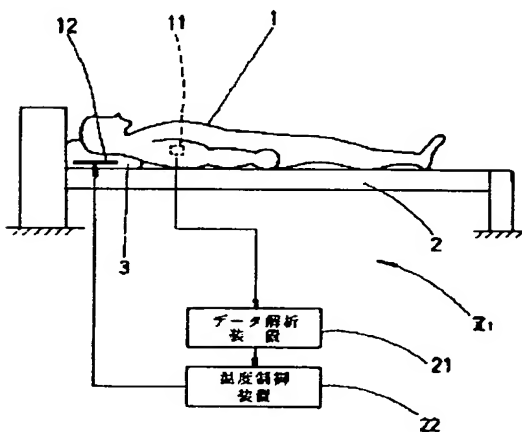
【図面の簡単な説明】

【図1】本願発明の第1実施例にかかる睡眠時における環境温度制御装置のシステム図である。

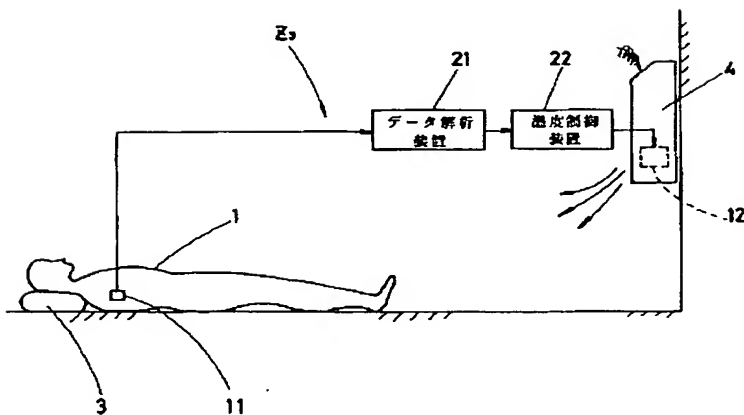
【図2】図1に示した睡眠時における環境温度制御装置の制御フローチャート図である。

【図3】本願発明の第2実施例にかかる睡眠時における

【図1】



【図4】



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環境温度制御装置のシステム図である。

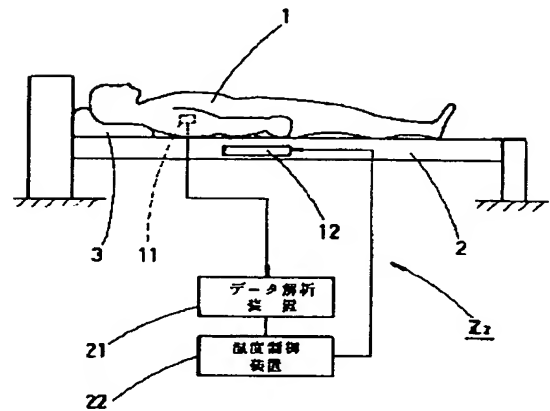
【図4】本願発明の第3実施例にかかる睡眠時における環境温度制御装置のシステム図である。

【図5】睡眠に最適な体温履歴を示す体温-時間相関図である。

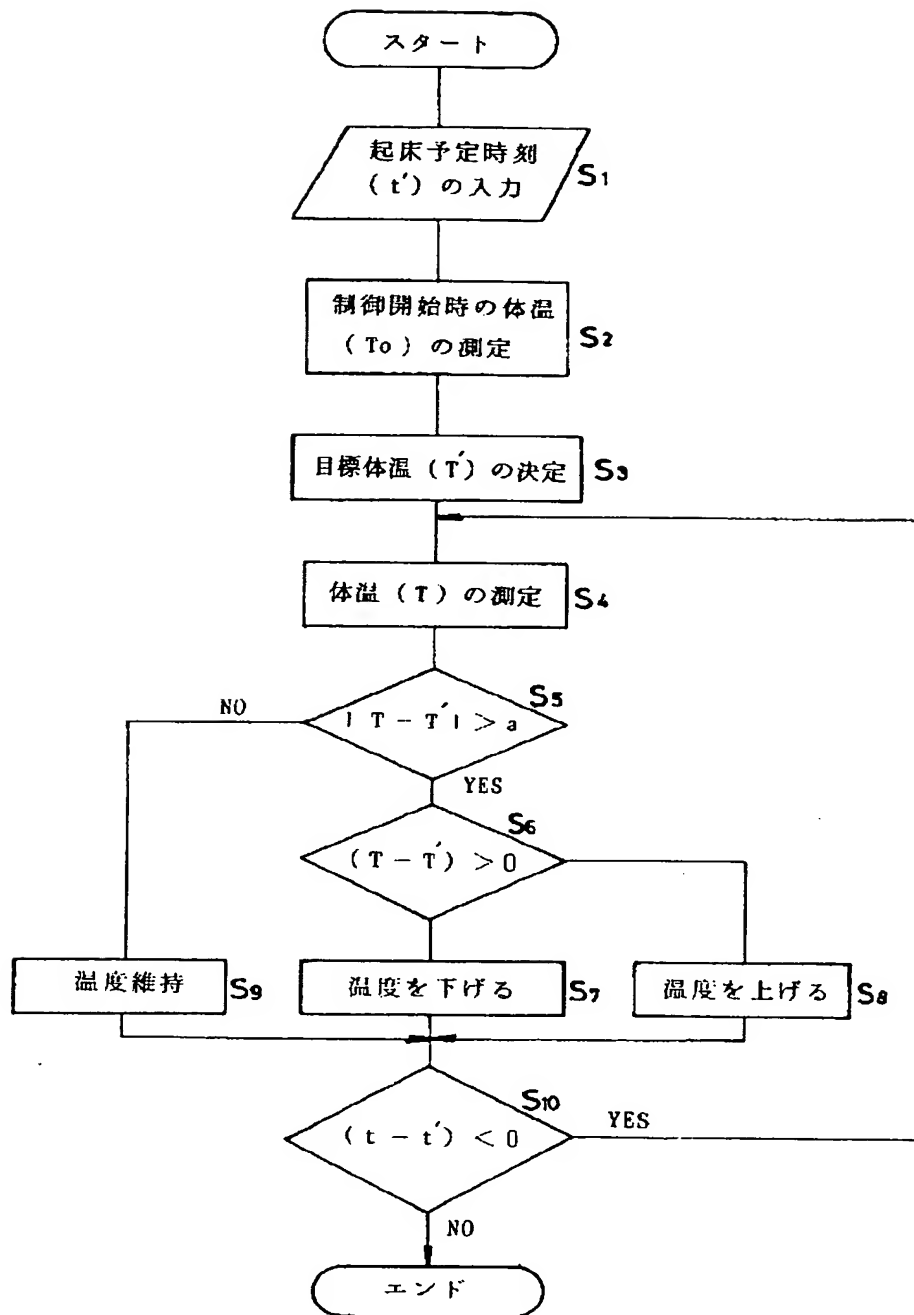
【符号の説明】

1は人間、2は寝台、3は枕、4は空調機、11は体温センサ、12は温度調整手段、21はデータ解析装置、22は温度調整手段である。

【図3】



【図2】





【図 5】

